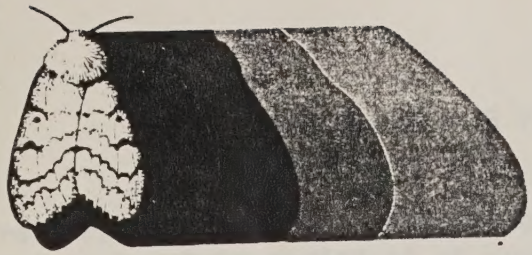
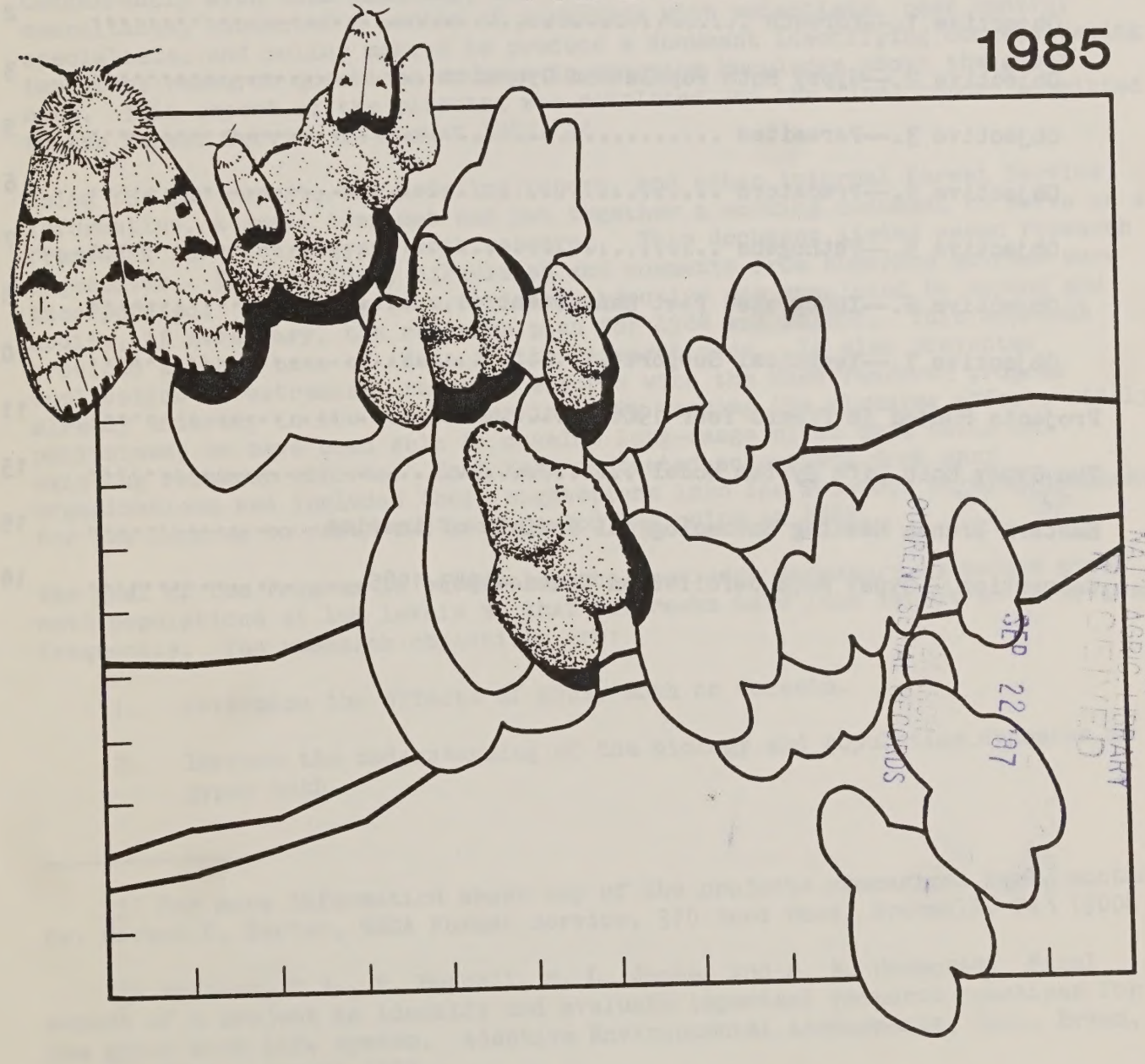
June 1986
Number 12



GYPSY MOTH NEWS

370 REED ROAD, BROOMALL, PA 19008
U.S.D.A., FOREST SERVICE

RESEARCH ACCOMPLISHMENTS 1985



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SUMMARY OF 1985 PROGRAM ACCOMPLISHMENTS 1/

The research aimed at developing improved approaches for management of the gypsy moth has been moving at an accelerated rate since 1982. Planning for the new initiative began in the winter of 1982 as a result of discussions between Denver Burns of the Forest Service and Charles Pitts of the Pennsylvania State University (PSU). Follow-up planning has involved representatives from the USDA's Forest Service, Agricultural Research Service (ARS), and Animal and Plant Health Inspection Service (APHIS) and many universities, industry representatives, and state agencies.

Concurrently with this planning, the Forest Service, aided by modeling consultants, conducted a series of workshops with scientists, pest control specialists, and policy makers to produce a document identifying and evaluating important research questions or gaps in existing knowledge about the gypsy moth. This aspect of the planning was completed and the final report submitted to the Forest Service in August 1983. 2/

Using the PSU report, the modeling report, and other internal Forest Service information, a small team met and put together a working document to serve as a framework for future gypsy moth research. This document listed seven research objectives. It was widely circulated and comments from numerous sources were incorporated. A writing team for each objective was appointed to expand and modify, if necessary, the research plan for 1984 and beyond. This approach provided a broad base of ideas in the research plan. It also prevented duplication of extramural research efforts with the base research program already underway in the Forest Service. By keeping the planning efforts widely publicized, we have been able to develop long-range plans that build on existing research efforts. Each team contacted scientists from many organizations and included their suggestions into the research working document for the Program to cover a 5-year period beginning in 1984.

The goal of the Program is to develop the knowledge necessary to manage gypsy moth populations at low levels so that outbreaks have less impact or occur less frequently. The research objectives are:

1. Determine the effects of gypsy moth on forests.

2. Improve the understanding of the biology and population dynamics of gypsy moth.

1/ For more information about any of the projects summarized here, contact Dr. Gerard D. Hertel, USDA Forest Service, 370 Reed Road, Broomall, PA 19008

2/ McNamee, P.J., P. Bunnell, M. L. Jones, and D. R. Marmorek. Final report of a project to identify and evaluate important research questions for the gypsy moth life system. Adaptive Environmental Assessments, Inc., Bryan, Texas, 182 p. August 1983.

3. Develop the means to utilize parasites as regulators in low level gypsy moth populations.

4. Determine the role of invertebrate and vertebrate predators in low level gypsy moth populations.

5. Determine the role of selected pathogens and develop technology to utilize them as regulators in low to medium gypsy moth populations.

6. Evaluate role of integrated pest management (IPM) for gypsy moth.

7. Develop scientific technical support for gypsy moth research.

Thirty-six projects were funded in 1984 to support the Northeastern Station's in-house research units. After a comprehensive research review held at Windsor Locks, Connecticut, in January, 1984, 27 projects were selected for 1985 funding (See Gypsy Moth News, September, 1985, number 10).

This report highlights accomplishments and lists the projects funded for 1986. A comprehensive research review is scheduled for the week of November 3, 1986, in Morgantown, West Virginia.

OBJECTIVE 1.--FORESTS

Research on the effects of gypsy moth on forests is centered around three areas: the impact on forest stands, including growth loss, mortality, and stand regeneration; understanding natural and man-caused mechanisms involved in the mortality process, and silvicultural treatments for minimizing impacts.

* Guidelines have been developed to aid forest managers and landowners in selecting and applying silvicultural treatments to minimize timber losses following gypsy moth defoliation. Arrangements have been made to demonstrate and test the guidelines on state and industrial forest lands. (USDA Forest Service; West Virginia Department of Agriculture, Forestry Division)

* The results of 8 years' measurement of gypsy moth defoliation on 600 plots in central Pennsylvania have been summarized; impact reports have been prepared and hazard rating guidelines released. (USDA Forest Service; Pennsylvania Bureau of Forestry)

* Monitoring is continuing on plots in western Pennsylvania to determine the effects of stand thinning and harvest practices on mortality, growth, and reproduction impacts caused by gypsy moth. (USDA Forest Service; Pennsylvania Bureau of Forestry)

* Data have been collected to describe site and stand conditions that influence mortality and growth loss following defoliation by a looper complex and by gypsy moth in the Ridge and Valley area of eastern West Virginia and western Maryland. Similar data have been collected in areas defoliated by the gypsy moth in the Appalachian Plateau province of Pennsylvania and West Virginia. (West Virginia University)

* A study has been completed to determine the type and rate of tree deterioration that might be expected after mortality resulting from gypsy moth defoliation and how this deterioration affects the salvage potential of trees killed by gypsy moth. (Pennsylvania State University)

* A technique has been tested for sampling to determine potential for Shoestring root rot infection on sites threatened by gypsy moth defoliation. Understanding of root rot infection potential and the effects of other disturbances should result in more accurate prediction of expected growth loss and mortality following gypsy moth defoliation. (USDA Forest Service; West Virginia University)

* It has been demonstrated that tree leaf chemistry and leaf quality as food for gypsy moth larvae differ with tree species and individual, with growing site, and with defoliation level. Leaf quality affects pupal weight, number and quality of eggs, and larval susceptibility to virus diseases. (Pennsylvania State University)

* The chemistry and food value of ridgetop oaks is being compared with that of mesic bottomland oaks. Two factors characteristic of susceptible sites, minimal inter- and intra-tree shading of foliage and soil moisture deficits were shown to result in higher foliage quality for caterpillars. (USDA Forest Service)

OBJECTIVE 2.--GYPSY MOTH POPULATION DYNAMICS

Population dynamics research is addressing several crucial areas. Studies undertaken include sampling gypsy moth, determining meteorological parameters of its forest environment, and clarifying the existence and/or role that forest sites susceptible to defoliation play in area-wide outbreaks. Cooperative research studies at sites in Vermont, Connecticut, Massachusetts, New York, Maryland, and Virginia:

* Established a series of 15-meter-diameter permanent study sites that demonstrated that forests susceptible to gypsy moth defoliation have higher populations than nearby forests resistant to defoliation. Site establishment demonstrated that accurate prediction measurements could be made and these were related to the stand physiographical condition. (Carey Arboretum; University of Massachusetts; University of Vermont; USDA Forest Service)

* Continued to monitor population densities in an attempt to ascertain how populations behave when they change from endemic to outbreak phases. Additional variables of "rockiness" have been included in the physiographic characterization of sites in Vermont, New York, Massachusetts, and Connecticut. (Carey Arboretum; University of Massachusetts; University of Vermont; USDA Forest Service)

* Released 112,000 partially sterile egg masses during 1985 in one such site in Pownale, Vermont, to suppress populations. Establishment was achieved but parasitism and predation substantially reduced populations. One interesting observation was that partially sterile larvae were found at least 500 meters from the ridgetop release site.

* Assembled comprehensive records of gypsy moth defoliation and climatic histories to explore and describe relationships between gypsy moth outbreak development and collapse and the climatic conditions that immediately preceed outbreaks. (University of Virginia)

* Developed a model to describe larval movement and partitioning within 15-meter-diameter plots, which will be used to test data from other plots. Burlap bands attract late instar larvae from nearby unbanded trees. Timing of band deployment influenced larval numbers under them; destruction of silk trails did not influence numbers of larvae under bands. (USDA Forest Service)

* Developed a regression equation that can be used to estimate total larval density per 15-meter-diameter plot, based upon larval numbers beneath burlap bands placed around tree boles. Previously, no such estimator was available. This development provides the means to monitor larval populations under sparse densities for pest management.

* Developed phenological model for gypsy moth development, which is being validated. Previously, it has been impossible to predict when to take action against gypsy moth in sparse populations where the insect cannot be observed. In preliminary trials in North Carolina and Oregon, this model demonstrated that it can be useful for timing intervention accuratly. (USDA Forest Service; University of Rhode Island)

* Developed a model of energy exchange in the gypsy moth. This model considers abiotic inputs (e.g. radiation, conduction, and convection transfer) and biotic inputs (food ingested/egested, digestive cost, locomotion cost) to derive a "cost-of living" budget. With this budget, effects of changes in environment or host food value can be evaluated. (University of Connecticut)

* Developed gypsy moth climate-space energy budget model. A preliminary forest meteorological model which predicts canopy, bole, and litter temperature; humidity; and radiation profiles has been

completed. It will be validated against meteorological data from equipment placed on weather towers within the Bryant Mountain study site. (University of Connecticut)

* Identified other invertebrates collected with gypsy moths captured with pyrethrin sprays. Their abundance has been quantified and insect species have been identified to order, many to family, and a number to genus and species. These data have been placed on the computer. Associations are being evaluated to test whether there are correlations between gypsy moth and other insect groupings. (USDA Forest Service)

OBJECTIVE 3.--PARASITES

Research on parasites of gypsy moth has, for the first time, developed the technology for determining their impact on gypsy moth populations on a generational basis. Scientists at the University of Massachusetts, University of Maryland, and University of Vermont, in cooperation with Forest Service scientists, have accumulated field and laboratory data, and developed models of parasite-host interaction to obtain first estimates of parasitoid-related mortality independent of compensatory action of other mortality factors. The completion of this work will add substantially to our ability to utilize parasites as regulators in low-level gypsy moth populations.

* Recoveries of marked larvae yielded important information on the level of parasitoid input independent of the compensatory action of other mortality factors. Combining the measured input with the weekly estimated host density, makes estimates of stage-specific "generational" mortality caused by any particular parasite possible. This continuing investigation, now in its third year ('84, '85, '86), provides a significant contribution to knowlege of parasites' effect on gypsy moth population dynamics during the low density part of the flush-crash cycle. (University of Massachusetts)

* The studies using marked larvae also provide information that helps identify the most appropriate moments in the generation to obtain estimates of parasitoid impact. For example, at what physiological host age can percent parasitism be used to estimate the actual impact on the gypsy moth population? These studies are continuing in 1986. (University of Massachusetts)

* Identification and relative densities of parasites active in low density populations in contiguous resistant and susceptible forest sites were determined in 1984 and 1985; significant differences in species and relative densities occurred between sites and from year to year. (University of Vermont; University of Massachusetts)

* Adult parasitoid sampling using a modified malaise trap identified peak activity periods to determine optimum sampling periods in contiguous resistant and susceptible forest sites. (University of Vermont)

* Determined the development time in degree-days of the immature stage of Cotesia melanoscelus and Blepharipa pratensis. Their host-susceptible stages were also determined. (University of Massachusetts; USDA Forest Service)

* Laboratory studies indicate that attack by Cotesia melanoscelus, causes higher levels of mortality in gypsy moth populations than would be indicated by determining percent parasitism alone. Significant nonreproductive (unascribed) mortality occured as a result of:

  1) larvae being stung more than once

  2) age of larvae; younger larvae were more susceptible

  3) the type of host food, with highest unascribed mortality occurring on hickory and maple

  (University of Maryland)

OBJECTIVE 4.--PREDATORS

Recently, emphasis in management of gypsy moth populations has shifted from crisis management toward IPM. This necessitates an understanding of the role of predators in low level populations. Current research is approaching this problem through: 1) an evaluation of gypsy moth mortality caused by vertebrate and invertebrate predator species (including searching behavior and effects of alternative foods on predation rate), 2) an understanding of the interactive relationships between predators and other natural enemies of the gypsy moth, and 3) the feasibility of manipulation of predator populations and habitat to enhance predation impact.

* Stomach content analysis of Peromyscus leucopus trapped during July on Bryant Mtn., VT, determined animal:plant food ratios for a resistant and susceptible site to be 2:1 and 1:3 respectively. This significant difference between diets is an important factor in understanding site susceptibility to gypsy moth defoliation. (USDA Forest Service)

* Shrub density and protective cover (1 m to 3 m in height) were shown to have a major effect on food selection and foraging behavior of P. leucopus. Mice on the ridge (a susceptible area where the shrub layer was noticebly absent) took 3 times as long to consume equal numbers of pupae as those mice inhabiting the resistant site (which had a dense shrub layer). Mouse densities were similar in the two areas. Both this observation and the one stated above have important implications for the gypsy moth focal area concept. (USDA Forest Service)

* Continued research in food preferences of selected species of wood warblers has suggested that the attack rate of gypsy moth larvae is directly proportional to the height class of the species, foraging field. Upper canopy feeders have the highest attack rate. This is further evidence that larval movement away from the canopy may have evolved to avoid natural enemies. (Southern Connecticut University)

* A nesting surrogate program was implemented. Several nests showed acceptance. Modifications for additional species and interaction enhancement promises detailed food analysis possibilities. (Southern Connecticut University)

* Field observations provided new data on feeding techniques for several warbler species, revealing the significance of some warblers that had been overlooked as important predators.

* New data were obtained on bird species feeding on various instars. Some species had not previously been listed as gypsy moth predators.

* Eight additional breeding bird censuses were completed in Pennsylvania hardwood forests that represented different cover types and topography. These censuses yielded important information on predator diversity and site susceptibility (to gypsy moth).

* Densities and species of avian and small mammal predators were ascertained in the four study sites and interpreted on the basis of forest physiography. Small mammal populations showed few differences, but the 60 species of birds showed habitat preferences.

OBJECTIVE 5.--PATHOGENS

Studies are being conducted to evaluate selected pathogens, e.g., NPV, strains of Bacillus thuringiensis, and protozoa, as regulators, either natural or artificially introduced, in static or pre-outbreak gypsy moth populations, and to develop and evaluate formulation and application systems for these agents.

* It has been demonstrated for the first time that the gypsy moth NPV can be transmitted transovarially from adult to egg to larva. Apparently the infection is persistent. (Boyce Thompson Institute)

* Results from studies on the dynamics of gypsy moth NPV in post-collapse, low-density populations indicate that a bimodal wave of virus mortality occurs. Virus mortality levels can be predicted by rearing larvae from eggs collected pre-season. (University of Massachusetts)

* Bioassay methods have been developed and are being compared to assay the level of natural NPV on foliage and leaves. (University of Massachusetts)

* A modified double antibody sandwich ELISA has been developed that detects NPV polyhedrin and nucleocapsid proteins in different life stages, and at a sensitivity of 20 ng/ml of NPV. (University of Maryland)

* At least three species of microsporidia collected from the gypsy moth in Portugal and Czechoslovakia were identified and characterized. These species demonstrated a debilitating effect on laboratory colonies and may be candidates for inoculative releases. (Illinois Natural History Survey)

* Aerial sampling techniques for evaluating the distribution of microbial spray deposits within the canopy have been developed. Results indicate a high degree of variation in the number of drops/cm^2 among leaves from the same crown location, and that swath width is very critical. (Pennsylvania State University)

* Laboratory studies were completed that determined the number of International Units (IU) of Bt required to kill gypsy moth larvae weighing 22-35 mg. (Pennsylvania State University)

* Results from companion studies suggest that microbial spray droplets below 150 microns require fewer IU's to achieve the same level of mortality of second instar gypsy moth larvae. (Pennsylvania State University)

* A more effective strain of Bt, NRD-12, has been developed and is commercially registered for use against several species of economically important Lepidoptera, i.e. Spodoptera. A new formulation of this strain is being tested with both ground and aerial applications against the gypsy moth. (USDA Forest Service; Agricultural Research Service; Maryland Department of Agriculture)

OBJECTIVE 6.--INTEGRATED PEST MANAGEMENT

Cooperative studies within this objective are designed to develop the technology to manage the gypsy moth at population levels below that causing visible damage and subsequent impact. This implies that we can prescribe (1) a monitoring system that indicates changes in trend of low to moderate density populations, (2) a decision-making process for users, and (3) environmentally sound tactics to address populations within a range of densities. Much of this research is complimentary to or in collaboration with the Maryland Gypsy Moth IPM Project that is being supported in part by the USDA Forest Service, Northeastern Area State and Private Forestry.

* F_1 sterile eggs were applied by hand and by aerial release in Maryland and in Vermont. The F_1 larvae developed in synchrony with native larvae, and adult sterile males competed successfully with native males. Results reaffirm the potential for using the inherited sterility technique in low-density populations. (USDA Forest

Service; University of Massachusetts; University of Vermont; Vermont Department of Forests, Parks, and Recreation; Maryland Department of Agriculture)

* Historically, many sites in the Northeast are known to be susceptible to gypsy moth defoliation. These have been identified through defoliation mapping and previous defoliation records. These sites offer an opportunity to monitor the population prior to major regionwide outbreaks. (State University of New York)

* A modified milk carton pheromone trap that was used for the first time in Massachusetts as a monitoring device effected a 50 percent reduction in the number of males trapped. Although this was a significant improvement, a goal of a 10-fold reduction must be achieved in order to prevent traps from becoming saturated (and therefore less efficient) in populations that are increasing. (USDA Forest Service; University of Massachusetts; Virginia Polytechnic Institute; Agriculture Research Service; Maryland Department of Agriculture)

* In Connecticut, a cooperative study is underway with the Eastern Connecticut Forest Landowners Association to utilize a simplified system of burlapped trees and pheromone traps to assess gypsy moth populations on their own properties. Our objective is to provide woodlot owners with the tools to monitor the gypsy moth and make their decisions on the need for control. (USDA Forest Service; Cooperative Extension at University of Connecticut)

* In Massachusetts, a statewide monitoring system for gypsy moth has been deployed and the data incorporated into a cartographic database. Software packages are used to generate graphics, contour plots, and trend analyses so that state officials are better informed about the status of populations and can therefore make better decisions about the need for suppressing them. (University of Massachusetts; Massachusetts Division of Forestry)

* The Gypsy Moth Life System Model (GMLSM) has been converted to standard FORTRAN and is now running on a mainframe computer at West Virginia University and on Forest Service Data General equipment in Morgantown. (USDA Forest Service)

* The stand submodel of the GMLSM has been revised and documented, and the documentation reviewed by a team of scientists and managers. To facilitate testing of the submodel, a separate program has been developed that allows the stand submodel to be run independent of the GMLSM. (USDA Forest Service)

* The gypsy moth submodel of the GMLSM has been extensively revised to incorporate several biological processes that were not included in the original version. (USDA Forest Service)

* Working groups and working group leaders have been identified and have agreed to participate in an intensive review of GMLSM stand, gypsy moth, parasite and predator, and pathogen submodels. The groups will meet individually through the spring and summer of 1986 to evaluate current model status, supplemental information that may be included, and additional research needs. All groups will meet together in the fall to discuss and further evaluate the GMLSM model as a whole. (USDA Forest Service and Cooperators)

OBJECTIVE 7.--TECHNICAL SUPPORT

The Technical Support Program provides for a consistent supply of high quality insects for research and development. The program reduces the costs to cooperators by eliminating the expense of maintaining their own laboratory stock, and it enhances the research by ensuring that relatively disease-free insects are consistently available. In addition, quality control programs are maintained to sustain the performance of the insect while increasing the efficiency of the rearing facility.

* Eleven university, State, and Federal cooperators were supplied with laboratory-reared gypsy moths. Gypsy moth strains supplied included the standard NJSS generation 27/28, and a close-to-wild strain in generation 3/4. In addition, colonies of gypsy moth parasites were maintained and supplied as needed. These included, Cotesia melanocelus, Ooencyrtus kuvanae, and Brachymeria intermedia. (USDA Forest Service)

* Approximately 1.2 million egg masses were produced during this period. The rearing method and the conditions under which they are being held were selected to provide egg masses which will be best suited for hatch during the 1986 wild gypsy moth hatching period. Of the 1.2 million egg masses, approximately 1.1 million are the progeny of males irradiated with 10 krads and normal females. The remaining 100,000 egg masses are progeny of males treated with either 8 or 6 krads and normal females. (APHIS)

* Results of testing determined that humidity during the embryonation period affects the degree of hatch. Therefore, during this production, all embryonating egg masses were held at high (70-80%) humidity. During the production period, improvements were also made in the pupal and egg harvesting procedures. (APHIS)

* Tests are continuing on ways to increase the length of time eggs can be held, which, in effect, would increase the production capacity by widening the production window. Additional tests are under way to improve mating container design and harvesting procedures. (APHIS; USDA Forest Service)

PROJECTS FUNDED IN FISCAL YEAR 1986

Northeastern Forest Experiment Station
Gypsy Moth Cooperative Projects

Investigator (Institution)	
	Objective 1 - Forests
Bill Merrill (Penn State Univ.)	Biodeterioration of oaks killed by gypsy moth defoliation
Ray Hicks (W. VA Univ.)	Determining mortality functions for gypsy moth defoliated stands in the Appalachian Plateau
Ray Hicks (W. VA Univ.)	Determining mortality functions for insect-defoliated stands in the Ridge and Valley Province of West Virginia
John Scrivanni (VA Polytech. & SU)	Determining growth impacts of defoliation by gypsy moth
Jack Schultz (Penn State Univ.)	Leaf quality of two oak species in gypsy moth-resistant and susceptible stands
Pedro Barbosa (Univ. Maryland)	Nutritional suitability of oaks in physiographic regions of Maryland as gypsy moth hosts
	Objective 2 - Gypsy Moth
Dave Miller (Univ. Conn.)	Quantification and prediction of the physical environment in gypsy moth (*Lymantria dispar* L.) habitats
Bruce Parker (Univ. Vermont)	Biological processes influencing gypsy moth populations in susceptible and resistant forests. A study of distribution and density of gypsy moths in and around foci on Bryant Mtn., VT
Clive Jones (Cary Arboretum)	Quantifying habitat-differentiated gypsy moth population dynamics at low densities
	Objective 3 - Parasites
Joe Elkinton (Univ. Mass.)	Evaluate and improve methods of sampling parasitoids of gypsy moth

Objective 4 - Predators

Bob Whitmore (W. VA Univ.)	Vertebrate predator and gypsy moth population interactions and their influence on defoliation
Noble Proctor (S. Conn. Univ.)	Effect of alternate food manipulation and silvicultural techniques for enhancement of avian predation on gypsy moth

Objective 5 - Pathogens

Joe Elkinton (Univ. Mass.)	Nucleopolyhedrosis virus dynamics in gypsy moth populations
Bill Yendol (Penn State Univ.)	A study plan to determine the distribution, total volume, and droplet characteristics of microbial pesticide sprays impinging on an oak canopy following aerial application, 1985-1986
Alan Wood (Boyce Thompson Inst.)	Persistent gypsy moth nucleopolyhedrosis virus infections
Robert Granados (Boyce Thompson Inst.)	Virulence of Lymantria dispar baculovirus: Effect of larval digestive fluids and peritrophic membrane on virus pathogenicity

Objective 6 - IPM

Joe Elkinton (Univ. Mass.)	Development of a gypsy moth population monitoring system
Bill Ravlin (VA Polytech. & SU)	Development of a gypsy moth population monitoring system
Charlie Pitts (Penn State Univ.)	Development of a gypsy moth population monitoring system - Pennsylvania
Bob Tichenor (MD Dept. Ag.)	Conduct and evaluate a pilot test to suppress gypsy moth populations in the Maryland Gypsy Moth IPM Area, using releases of F-1 sterile eggs
Bruce Parker (Univ. Vermont)	Use of inherited sterility for suppressin low density gypsy moth populations in Vermont
Karen Wilson (NC Dept. Ag.)	Assistance in analyzing and refining the Gypsy Moth Life System Model

Objective 7 - Technical Support

Chuck Schwalbe (APHIS)	Stockpile eggs for sterile male
Tom ODell (USDA FS)	Quality control of reared insect

THE GYPSY MOTH LIFE SYSTEM MODEL

Here is a brief description of the work being done on the Gypsy Moth Life System Model as described under research objective G, Integrated Pest Management.

The Gypsy Moth Life System Model (GMLSM) simulates the population dynamics of gypsy moth and the effects of gypsy moth defoliation on stand growth and yield. This model has 2 main objectives: to summarize and organize existing knowledge about gypsy moth, and to identify topics that deserve additional research. Through several workshops, the knowledge of experts from a wide range of disciplines has been incorporated into the model. Model components include tree growth and mortality, gypsy moth feeding and growth, gypsy moth natural enemies (parasites, predators, and pathogens), and compensatory mortality. Current work on this model is aimed at evaluating and improving the individual components of the complete model.

While much more work will be needed to finish revising and testing the GMLSM, 2 different sections of the model are being extracted from the complete model and, with minor revisions, made available as independent models. Figures 1 and 2 demonstrate the information that these "spinoff" models will be able to provide once they are completed.

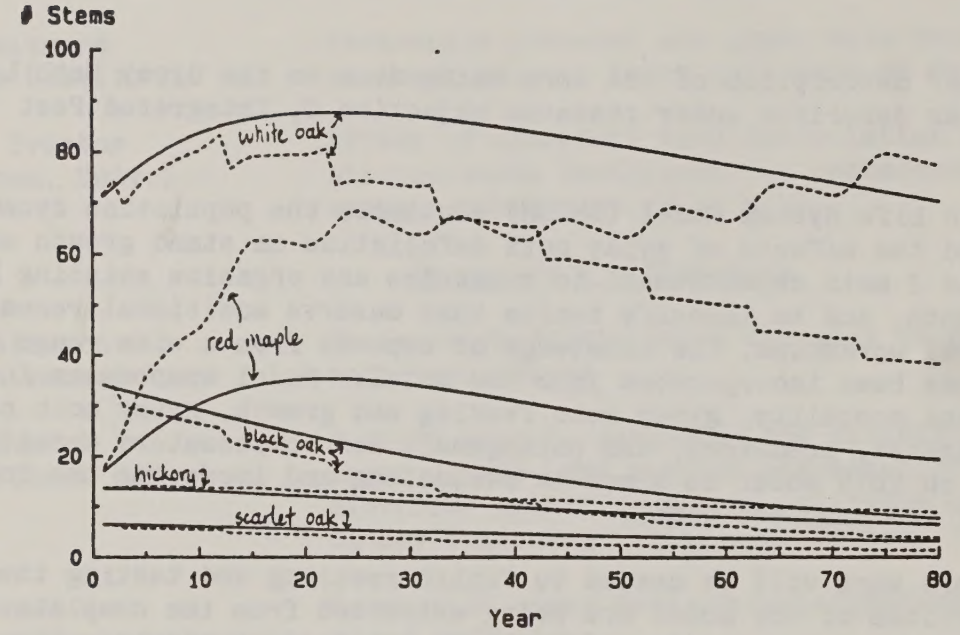
Do you want to know what effects a certain pattern of defoliation will have on your stand? Figure 1 shows the effects of one possible pattern of defoliation that was "applied" every 10 years to a stand in central Pennsylvania. This model also predicts changes in basal area volume and mean diameter at breast height over time. Managers could use this model to examine the results of a number of different defoliation scenarios--thus getting a handle on what might happen to the stand under best-case and worst-case assumptions.

When will the gypsy moth populations in a stand reach peak second instar? Or peak fourth instar? The phenology model uses daily weather data supplied by the user--either actual data or average values--to predict the timing of gypsy moth development. The proportion of gypsy moths in each life stage is then calculated, as show in Figure 2. In this example, on May 27 the gypsy moth population consisted of approximately 20 percent first instars, 60 percent second instars, and 20 percent third instars.

The 2 models whose output is shown in Figures 1 and 2 are still being developed and tested. If you have any suggestions regarding those models, or if you want additional information, contact K. Sheehan, USDA Forest Service, P. O. Box 4360, Morgantown, WV 26505.

FIGURE 1

Number of Overstory Stems

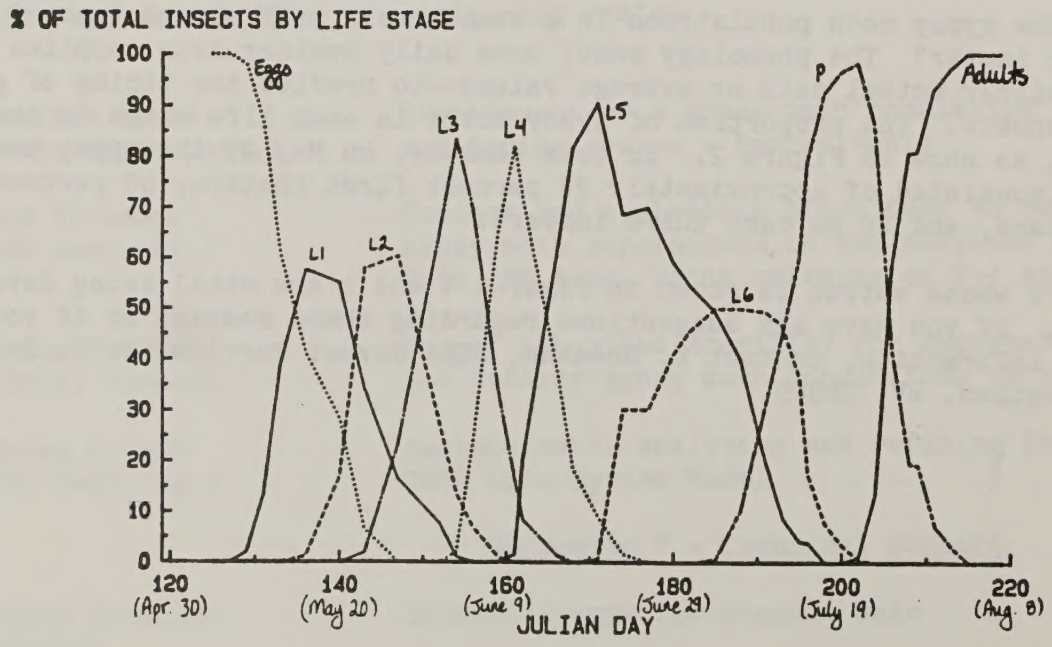


solid lines = no defoliation
dashed lines = defoliation every 10 years

Effects of defoliation by gypsy moth every 10 years on the number of stems (Figure 1) by species for a stand in central Pennsylvania.

FIGURE 2

GYPSY MOTH DEVELOPMENT



egg hatch pattern: Yokohama (125)

Timing of different gypsy moth life stages during the course of a year.

EASTERN BRANCH MEETING ENTOMOLOGICAL SOCIETY OF AMERICA
PHILADELPHIA
OCTOBER 6-8, 1986

Advances in Sampling and Forecasting Gypsy Moth Populations

Douglas M. Kolodny-Hirsch
Maryland Department of Agriculture
Annapolis, MD

Michael L. McManus
USDA Forest Service
Hamden, CT

INTRODUCTION: D. M. Kolodny-Hirsch

9:00-9:30 Methods for the masses: An egg-centric view of sampling and forecasting gypsy moth populations. C. G. Jones; Institute of Ecosystem studies. The New York Botanical Gardens. Mary Flager Cary Arboretum 12545.

9:30-10:00 Spatial analyses of gypsy moth egg mass abundance in relation to regional landscape features. D. M. Kolodny-Hirsch, M. L. McManus, and R.C. Reardon. Maryland Department of Agriculture, Gypsy Moth IPM, Annapolis, Maryland 21401.

10:00-10:30 Influence of tree species and bark texture on burlap band sampling for pupae. F. W. Ravlin and R. G. Bellinger. Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

10:30-11:00 Methods from the frasses: Sorting through the scat in gypsy moth survivorship patterns. A. M. Liebhold and J. E. Elkington. Department of Entomology, University of Massachusetts, Amherst, Massachusetts 01003.

11:00-11:30 Methods based on gases: Ordinating with odor or sampling with stench. R. T. Carde' and J. E. Elkington. Department of Entomology, University of Massachusetts, Amherst, Massachusetts 01003.

11:30-12:00 Quantification of gypsy moth aerial density. R. A. J. Taylor. Department of Entomology, Pennsylvania State University, University Park, Pennsylvania 16802.

CONCLUSION: M. L. McManus

The defoliation table printed in the March issue of Gypsy Moth News contained several errors for Maryland and Pennsylvania. The following table contain the correct defofliation figures.

GYPSY MOTH DEFOFLIATION TREND 1983 - 1985

STATE	1983	1984	1985
		ACRES	
CONNECTICUT	153,239	544	89,544
DELAWARE	2,992	14,203	5,144
MAINE	16,285	1,892	6,698
MARYLAND	15,870	41,824	83,488
MASSACHUSETTS	148,133	185,520	414,084
MICHIGAN	457	6,425	18,460
NEW HAMPSHIRE	560	----	----
NEW JERSEY	340,285	98,695	239,350
NEW YORK	290,843	33,678	129,820
PENNSYLVANIA	1,360,824	450,642	581,113
RHODE ISLAND	53,880	164,600	133,920
VERMONT	----	----	----
VIRGINIA	----	374	5,200
WEST VIRGINIA	----	----	----
TOTAL	2,383,368	998,397	1,709,291